



LARSEN & TOUBRO

It's all about Imagineering

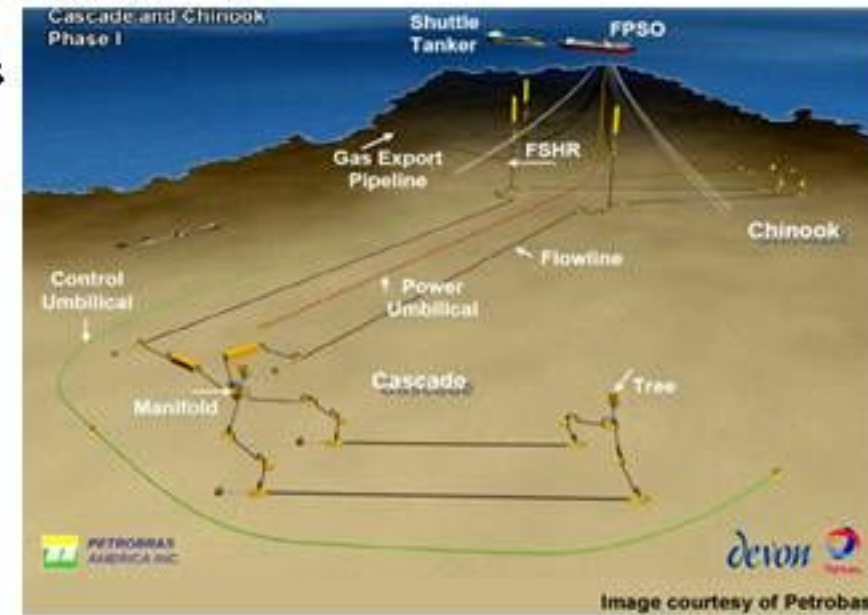
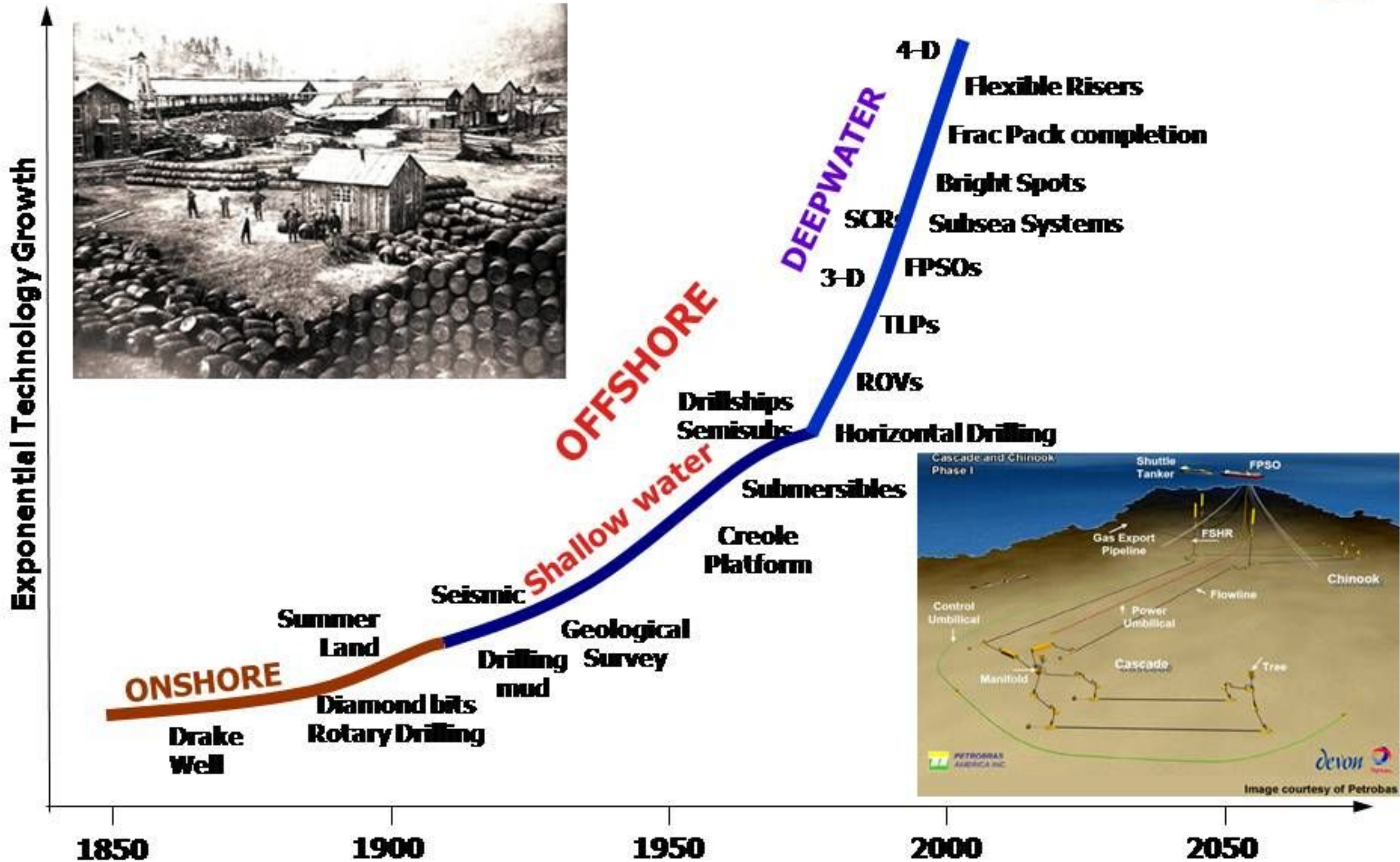
Subsea Field Development Challenges and Opportunities

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The Journey of 150 Years



Oil & Gas E&P Technology Evolution

Challenges in Subsea Field Development



- ❑ Technology Challenges
- ❑ Installation Challenges
- ❑ Operational Challenges

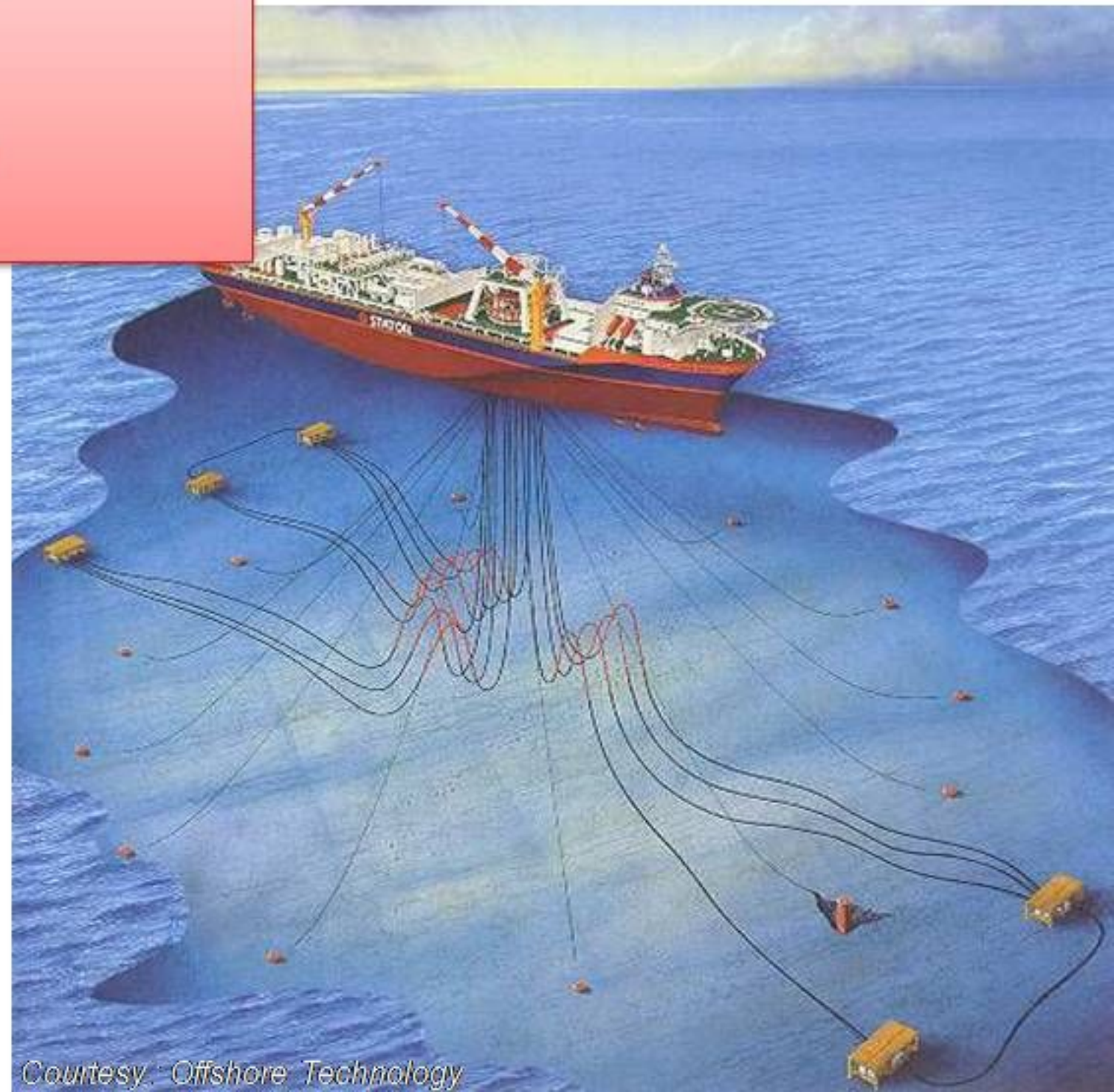




Challenges in Subsea Field Development

1. Field Location & Water Depth
2. Reservoir Chemistry
3. Metocean Conditions
4. Geophysical Data
5. Emerging Technology

Technology Challenges



Courtesy: Offshore Technology



Technology Challenges

1. Field Location and Water Depth

❑ Remoteness

- Distance from shore
- Distance from other Infrastructure
- Tie-back - existing facilities / Shore
- Developing Countries

❑ Depth (typically more than 300 m)

- Hydrostatic Pressure

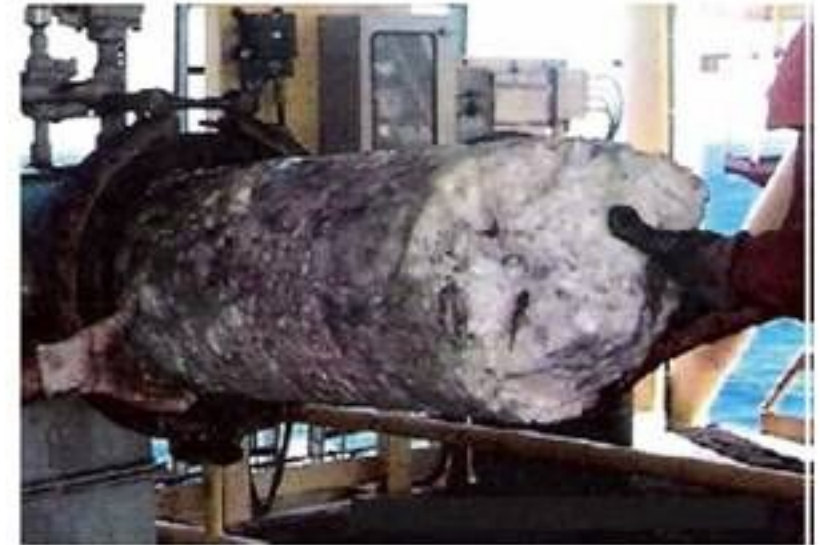




Technology Challenges

2. Reservoir Chemistry / Difficult Hydrocarbons

- **Reservoir uncertainties**
 - Wells not producing
 - Changes in reservoir chemistry
- **Robustness of design**
- **Flow Assurance**
 - Heavy, viscous crude oil
 - Low seabed temperatures
 - Hydrates / water / gas / oil
- **Material Selection – hot & Sour Production**
- **Intervention Methods**





Technology Challenges

3. Metocean Conditions

- Severe Surface Conditions - wind, wave, current)
- Deep Ocean Currents – limited information
- Seabed Temperature - insulation, hydrate formation
- Installation constraints
- Operating constraints

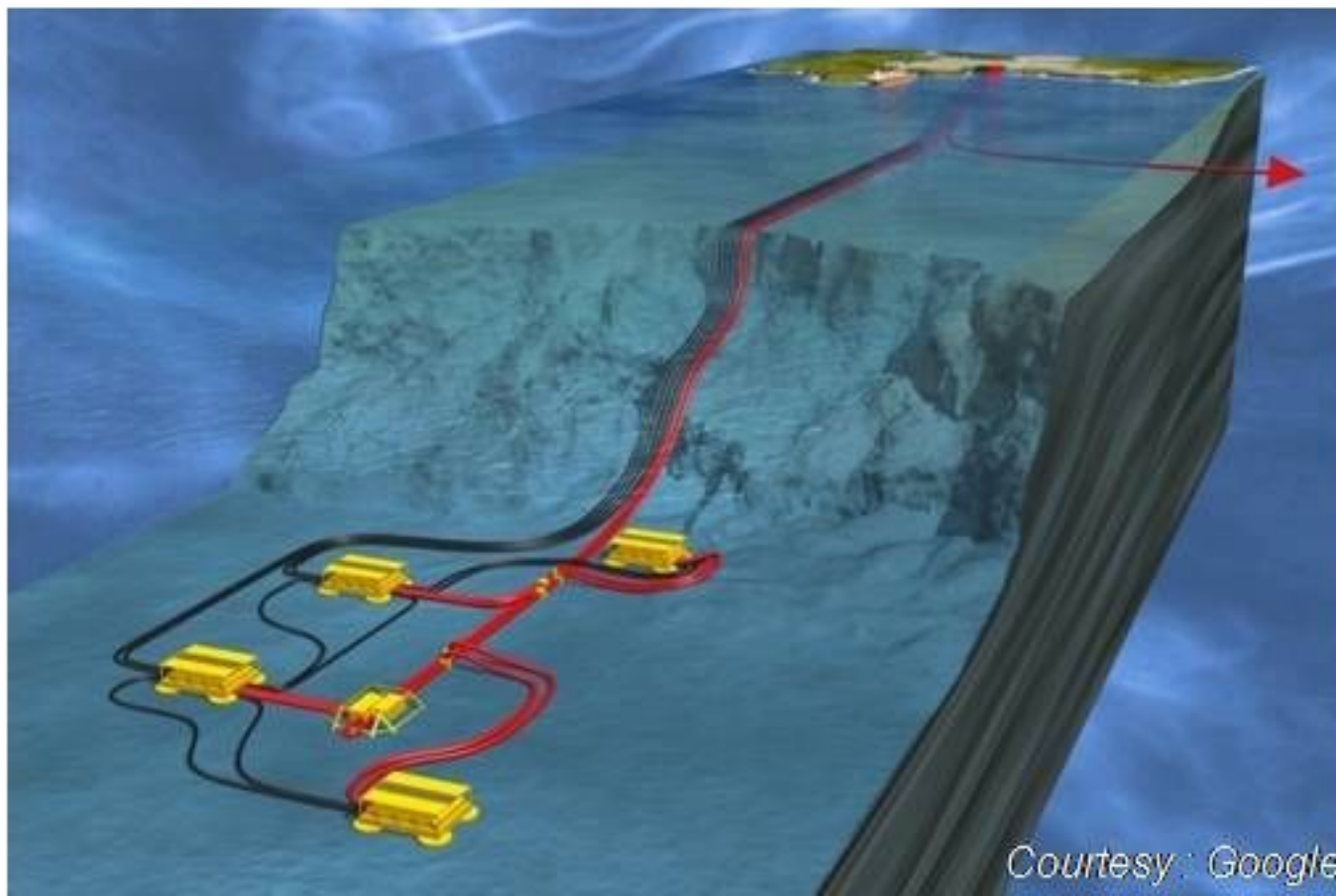




Technology Challenges

4. Geophysical Data

- **Foundation Design**
- **Stability Issues – Slope failures**
- **Seismic events**
- **ROV Operations – Visibility**



Technology Challenges

5. Emerging Technology

- ❑ Complex Reservoir - shallow pay zones, multiple zones
- ❑ Reservoir uncertainties & recovery rates.
- ❑ Deeper Water depths and flow assurance problems.
- ❑ Constant Technology GAPS.
- ❑ Technology Upgrades through Joint Industry Programs (JIP)
- ❑ New frontier is Subsea Processing.
 - Multiphase pumping / Gas Liquid Separation / Three phase separation

Joint Industry Programs (JIP) are initiatives for bridging technology Gaps with joint participation of Academia, EPIC Industry and E&P Operator



Challenges in Subsea Field Development

1. Field Development Strategy
2. Flowlines Design
3. Vessel Availability
4. Subsea Completion techniques

Installation Challenges

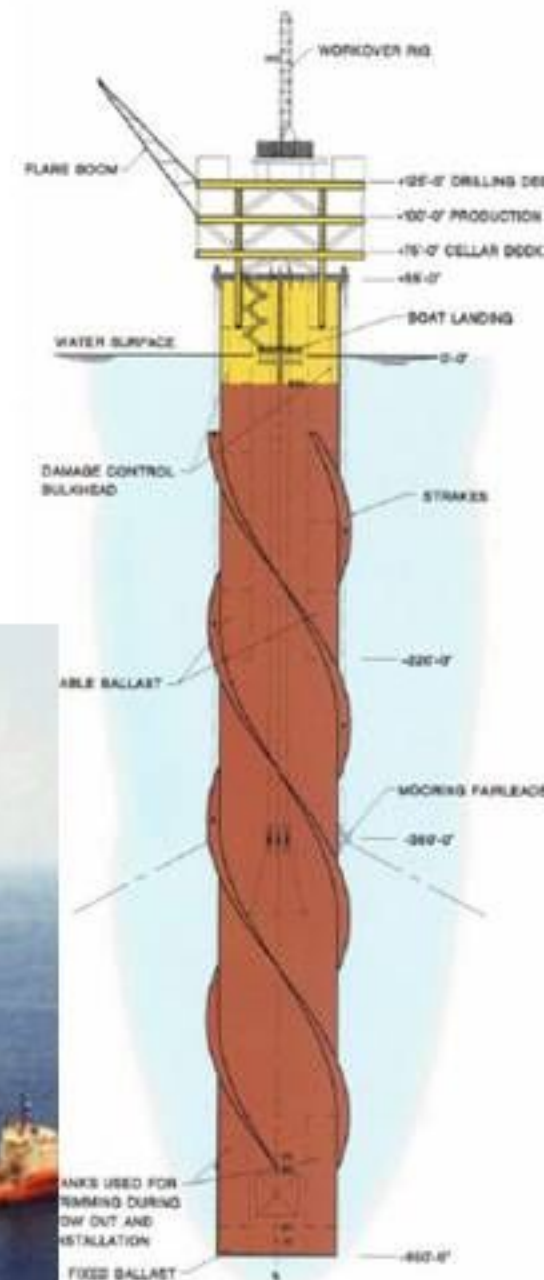




Installation Challenges

1. Field Development Strategy

- Type of Development - SPAR / TLP / Subsea
- Drilling Completion - Completed well / Re-entry
- Existing and Future Tie-backs
- Shore Approach
- Future Water injection





Installation Challenges

2. Flowline Design

- Type of flowlines
- Seabed inconsistencies
- Insulation techniques
- Local regulations / Ecological impacts
- Existing infrastructure / subsea pipelines
- PLET Design / Deployment technique
- Subsea Tie-in Techniques





Installation Challenges

3. Vessel Availability

- Limited number of Installation vessels
- The type of development in the region
- Level of Deepwater activity in the region and globally
- Clash of working season with other regions
- Working season & Metocean Conditions

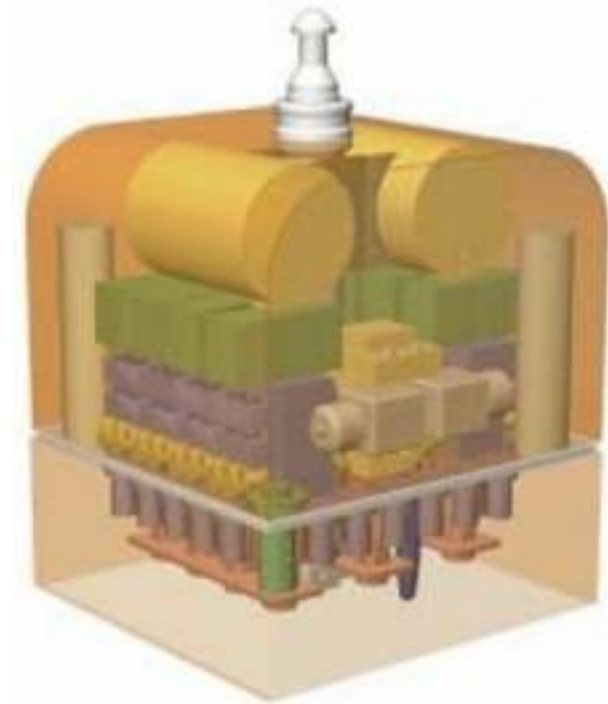




Installation Challenges

4. Subsea Completion Techniques / Tooling

- Hardware Installation - Guided / Guideless
- Tie-in Tooling requirements
- Landing Tolerances and tooling interface





Challenges in Subsea Field Development

1. Skilled Manpower
2. Interface Management
3. Testing
4. HSE

Operational Challenges





Operational Challenges

1. Availability of skilled man-power

- The increased activities in the Oil & Gas sector
- Limited pool of experienced personnel
- Industry nature – rugged & unstable
- High attrition rates in Asia
- Technology transfer not happening with high attrition rates





Operational Challenges

2. Interface Management



Interface Management is crucial as it continues through the whole life cycle of the project including operations



Operational Challenges

3. Testing

- Once offshore, No opportunity for correction
- Testing more rigorous at all stages.
 - Component FAT
 - Sub-system FAT / System FAT
 - EFAT / SIT
- System Integration Test (SIT) to be comprehensive



There is No Opportunity for Corrections or It can be very Costly, so "GET IT RIGHT THE FIRST TIME".



Operational Challenges

4. HSE

- ❑ Establish

- Engine
- Manu
- Install
- Opera
- Decor

- ❑ Regular
compliance

- ❑ Resource
loss is in



Deepwater Horizon accident costed 11 lives & environmental disaster yet to be assessed

'Prevention is better than Cure' and '*Prevention*' becomes more potent when there is no 'cure'.



Challenges in Subsea Field Development

Conclusion

- Full & Detailed Reservoir modeling
- Comprehensive field data
- Concept Definition / FEED
- Choice of right Technology – Reliable & Proven
- Robustness of design
- Flexibility for future developments
- Comprehensive Testing & Quality plan
- Reliable Installation Contractor with local knowledge
- Ease in intervention / maintenance
- Build talent pool – locally & internationally
- Comprehensive HSE Procedures

Q & A



Thank you
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